

OBITUARY



Ivano Bertini 1940–2012

Harry Barkus Gray, Lucia Banci, Claudio Luchinat & Paola Turano

Ivano Bertini was one of a kind. You could always tell when he was near, as his booming voice made the walls tremble and everyone within them take notice. He loved life and his friends with a passion that is rarely seen. Finding he had lung cancer, he fought bravely but passed away on 7 July of this year. In his scientific life, he took biological inorganic chemistry to new heights with the development of powerful new NMR methods to study paramagnetic metalloproteins. And, equally importantly to us and to many others, he and his beautiful wife, Renata, were lovable, caring and fiercely loyal friends.

Born on 6 December 1940, in Pisa, Italy, Ivano obtained a doctorate in chemistry *cum laude* at the University of Florence, in 1964. He stayed with his mentor Luigi Sacconi in Florence until 1975 when he was appointed full professor at the university. Immensely interested in the role of inorganic chemistry in biology, he felt that real progress on the most challenging problems could only be made after the development of powerful new biophysical methods for experimental investigations. His method of choice was NMR.

A visit to the ETH Zurich in 1965 culminated in Ivano's first NMR paper¹. He subsequently worked with Bill Horrocks at Princeton University (1968–1969) on NMR of paramagnetic complexes. He began his work on metals in biology in 1974 during a very productive period of collaboration with one of us (H.B.G.). And shortly thereafter, in Florence, he cleverly employed paramagnetic metal-ion probes to elucidate the mechanisms of action of several zinc enzymes, including carbonic anhydrase, carboxypeptidase, alcohol dehydrogenase and superoxide dismutase. During this period, he developed a strong interest in both theoretical and experimental studies of nuclear and electron relaxation processes. He teamed up with IBM's Seymour Koenig, who had a homemade relaxometer for nuclear relaxation experiments at variable magnetic fields. Following his work with Koenig, in 1994, he determined the first NMR solution structure of a paramagnetic metalloprotein, the high-potential iron-sulfur protein I from *Ectothiorhodospira halophila*². Over 160 protein structures have been solved in the lab in Florence since that landmark work was published. Thanks to his strong theoretical background in electron and nuclear

relaxation, as well his knowledge of the physics that produces hyperfine shifts, he then developed protocols to solve challenging macromolecular structures, taking advantage of paramagnetic-based, nonconventional NMR restraints. Notably, these protocols have been incorporated into many widely used analysis programs.

During his final years, he made major contributions that have shed new light on metal trafficking pathways and on the structures of multidomain protein assemblies. Of special interest is his work on the development of a library of protonless NMR experiments suitable for high-molecular-weight (even unfolded paramagnetic) molecules. His focus shifted to biomedical applications, with emphasis on metalloproteinases as well as other metalloproteins of pharmaceutical interest. He also pursued research on NMR-based metabolomics.

Ivano will long be remembered for building a world-class laboratory. When starting out in 1989, he had only two NMR spectrometers (200 and 600 MHz), housed in a former church in central Florence that featured sixteenth-century Renaissance frescos on walls with vaulted ceilings. By 1999, there was no room for new spectrometers, so he founded the Center for Magnetic Resonance (CERM; <http://www.cerm.unifi.it>) and moved to become the first occupant of the new science campus of the University of Florence. (The CERM was recognized as a center of excellence by



Ivano Bertini and colleagues on the occasion of the award of the Fiorino d'Oro, the highest award of the City of Florence, Sunday 24 June 2012. From left to right: Lucia Banci, Antonio Rosato, Rebecca Del Conte, Paola Turano, Ivano Bertini, Claudio Luchinat, Roberta Pierattelli, Mario Piccioli, Marco Fragai and Simone Ciofi.

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the university in 2003.) Today, in a building of about 1,600 square meters, scientists have access to an impressive collection of NMR instruments for solution and solid-state NMR experiments guided by a team of outstanding scientists. A man with seemingly infinite energy, Ivano founded two biotech companies, served as president of the Italian Chemical Society and cofounded the European network on NMR facilities for bio-NMR. His lab has been funded by the European Commission as an NMR infrastructure site since 1994 and as a computational 'e-infrastructure' site since 2007. In 2008, CERM became one of only seven core labs of INSTRUCT, an infrastructure of the European Strategy Forum on Research Infrastructures.

Ivano was in a class of his own when it came to hosting fabulous international conferences at which scientists could discuss their very latest results in the most attractive of locations, including the Chianti Workshop on Magnetic Resonance (1984), the Eurasia Conference on Chemistry (1988) and the International Conference on Bioinorganic Chemistry (ICBIC; 1983). To quote him, there was a need for "organizing

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the bioinorganic community, which, according to me, was being squeezed between chemistry and biology.” The field of bioinorganic chemistry owes an enormous amount to his leadership. During the second European Research Conference on Chemistry of Metal Ions, held in San Miniato (Italy) in April 1995, Ivano, who was chair of the conference, convinced several colleagues (H.B.G., Bo Malmström, Helmut Sigel and others) that there should be a permanent international society. The Society of Biological Inorganic Chemistry (SBIC) was founded the following August, and the *Journal of Biological Inorganic Chemistry* soon after (with Ivano as Chief Editor).

Looking back, it is clear how his personal relationships guided Ivano's development. In remembering him, one of us (P.T.), who joined his group 25 years ago, put it this way: “I have never seen Ivano without people around him. He had a strong personality. He was a tireless worker, never satisfied with himself and collaborators, always looking for new goals. Not all were able to work and live with him; he has lost collaborators and pupils along his way. But there are people with whom he has shared most of his scientific life: as declared by him, all his achievements were possible thanks to the collaboration with C.L. from 1975 and L.B. from 1983.” Early contact with the company Trüb Täuber, whose NMR spectroscopy division became Spectrospin AG, in Fallanden, led to friendships with Bruker founder Günther Laukien and his successor Tony Keller. The birth of the first large-scale facility for bio-NMR can be traced to his interactions with others, notably Heinz Rüterjans and Robert Kaptein.

Ivano published over 700 research papers that document his contributions, and his 2007 book *Biological Inorganic Chemistry* (written with H.B.G., the late Edward I. Stiefel and Joan Selverstone Valentine)



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Ivano Bertini and Harry B. Gray at Caltech.

has introduced many young people to the field. A distinguished member of the Accademia Nazionale dei Lincei, he received many other honors, including one from the California Institute of Technology. He was especially proud of his honorary degrees (*laurea honoris causa*) from Stockholm University (chemistry, 1998), the University of Ioannina (chemistry, 2002) and the University of Siena (biological sciences, 2003).

1. Thwaites, J.D., Bertini, I. & Sacconi, L. *Inorg. Chem.* **5**, 1036–1041 (1966).
2. Banci, L. *et al. Eur. J. Biochem.* **225**, 715–725 (1994).